CONFERENCE O
PRESENT AND FUTUR
OF INDOOR AIR QUALITY
CONFERENCE SUR
LE PRESENT ET LE FUTUR
DE LA QUALITE DE L'AIR AMBIANT

ABSTRACTS
RESUMES

Brussels Congress Centre
Palais des Congrès de Bruxelles

14, 15 & 16. II. 1989

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ORAL SESSION

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O1 CANCER CONTROL AND LIFESTYLE MEDICINE

E.L. Wynder (American Health Foundation, USA)

It is an often stated maxim that we have it within our biological capacity not to die from many kinds of disease. There is only one unavoidable cause of death-old age. In the industrialized world, science and technology have enabled man to overcome most of the infectious and dietary deficiency diseases of the past. Unfortunately, in their stead, we have created a series of diseases that are largely a part of our personal and excessive lifestyles. What we smoke, eat and drink, as well as any drug abuse and unhealthy sexual practices, are the factors that produce a cellular exposure with which our biological system cannot cope, in short, metabolic overload.

The reduction or modification of these factors, and hence, a decline in illness, disability and death, is a goal that can be accomplished immediately on the basis of our existing knowledge, without having to know the precise mechanisms of action involved in how these risk factors lead to disease. In terms of cancer, accomplishing this goal means an aggressive program of cancer control. In general, these lifestyle factors have been uncovered through epidemiology, a science that has contributed significantly to our understanding of the etiology of disease and its prevention.

O2 BIOMARKERS OF EXPOSURE: HOW PRACTICAL, HOW USEFUL

S.L. Schwartz & N.J. Balter (Georgetown University, School of Medicine, Washington DC, USA)

The first task of the epidemiologist is to determine whether or not there is a certain disease occurrence pattern within a finite population. If such a pattern is found, the next issue is to ascertain what features set apart that population from another not so affected. A well done epidemiological study will identify association, if it exists. Rarely, on the other hand, is causation identified. The limited ability to establish causation is a focus of health policy and regulatory frustration. Indoor air pollution and its "sick building syndrome" outcome is a fitting example of the conflict ensuing from the need for a remedy where the specific cause is unknown. In this connection, identification of biological markers is an increasingly popular means of establishing exposure to particular components of the indoor air. Properly utilized biomarkers can add significantly to the cause and effect analytical process. They can be used to prospectively study acutely or chronically exposed populations, they can be used to assess and improve the power of questionnaires employed in retrospective studies.

There are some important considerations in the realistic application of biomarkers. Specificity is a very important, but not necessarily exclusionary, criterion. For example, nicotine or a metabolite in body fluids are specific for tobacco smoke exposure where as carbon monoxide as carboxyhemoglobin is indicative of exposure to any combustion product or even to a metabolic precursor such as methylene chloride. Yet, the presence of abnormally high carboxyhemoglobin can help in weighting the causative potential among a number of candidates agents including microbial organisms.

A thorough knowledge of biomarker pharmacokinetics is necessary to adequately establish study design and sampling procedures. It is the only means by which the quantitative data can be obtained for establishing dose-response relationships. It is also the only means by which exposure to the biomarker or its precursor can be evaluated for its attribution to the environment in question.

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There are limitations in interpretations for biomarker dose-response data. For example it need not be a foregone conclusion that increase in relative disease risk and biomarker level are related by a slope equaling unity. The convenience of being able to measure a biomarker for one exposure should not preclude consideration of other causation candidates that are not so easily detected through biomarker approaches.

03 THE SICK BUILDING SYNDROME: CLINICAL ASPECT AND PREVENTION

C. Molina (Université de Clermont Ferrand, France)

The sick building syndrome (SBS) is the name given to a set of varied symptoms experienced by a number of people working predominantly in hermetically sealed and air-conditioned buildings.

The syndrome, which is probably multifactorial, is not, as a rule, accompanied by any organic lesion or discernible physical sign.

EXTENT OF THE PROBLEM

This is a worldwide problem because air conditioning is used in many different situations for the purposes of comfort, safety and even noise abatement.

The current literature suggest that 20 to 30% of office employees regularly experience symptoms of SBS which probably reduce their working efficiency.

SYMPTOMATOLOGY

The symptomatology includes different classes of symptoms: mainly

- *Respiratory manifestations*
- *Neuropsychic symptoms* (headache, lethargy) and sometimes ocular, cutaneous or sensory manifestations.

These disorders disappear during the week-end and holidays. Their intensity increase throughout the day. The affect predominantly women and atopic patients. Their benignity is confirmed by many studies.

DIAGNOSIS

Diagnosis of sick building syndrome (SBS) should be confirmed once all other building-related-illnesses have been eliminated: *infectious* disease (Legionella-type which have an easily recognizable acute clinical picture), *allergic manifestations* such as Hypersensitivity pneumonitis due to thermophilic actinomycetes, or *humidifier* fever (with mild physical signs, normal pulmonary X-ray but precipitating antibodies to a number of microorganisms found in humidifier suggesting also the role of endotoxins), or *allergic rhinitis*.

ETIOLOGY

A considerable number of factors are supposed to provoke SBS: *physical factors* (temperature, relative humidity, ventilation, air speed, artificial light, vibrations, ions), *chemical factors* (smoke, volatile organic compounds, Formaldehyde, CO2, CO, NO2, SO2), *biological factors*: dusts and various particles such as germs (actinomycetes) or moulds, *psychological factors*.

TREATMENT

It is not specific because it is a multifactorial syndrome. But it is possible to make some

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recommendations for reducing the number of complaints, improving air quality, preventing microbiological contamination or reducing the concentration of certain chemical substances.

They involved:

- the siting of air-conditioning system (far from cooling towers).
- humidification must avoid the stagnation of water (access to the installation ducts must be easy).
- the filters must be efficient and placed as near as possible to the source to be guarded.
- installation monitoring and maintenance require qualifications of technicians.

CONCLUSION

In conclusion these health problems related to building must be recognized not only by doctors, who have to provide for their prevention and treatment, but also by architects, engineers, building experts, designers of large tower blocks and air-conditioning specialists.

04 L'AIR AMBIANT, PERCEPTIONS ET SEUILS DE TOLÉRANCE: DES NORMES SOCIALES EN CHANGEMENT

N. Delruelle (Institut de Sociologie, Université Libre de Bruxelles, Belgique)

Dans les enquêtes d'opinion réalisées en Belgique depuis une quinzaine d'années, la qualité de l'air ambiant est un thème qui sensibilise de plus en plus de larges couches de l'opinion publique. Cet aspect de la qualité de la vie englobe d'ailleurs au plan des représentations des facettes de plus en plus diversifiées: pollution automobile et des chauffages domestiques dans les villes, pollution industrielle, pollution par le tabac dans les lieux publics.

L'émergence de cette sensibilisation qui n'est pas uniforme dans toutes les catégories sociales, procède de véritables normes socio-culturelles qu'il faut comprendre dans l'ensemble des transformations socio-culturelles de nos sociétés. Il faut savoir aussi que l'émergence de cette sensibilisation n'est pas sans effet sur l'environnement, spécialement celui des zones urbaines et des zones urbanisées.

Comme toutes représentations, celles relatives à l'air ambiant sont, en effet, à la fois le reflet des valeurs sociales d'une époque et d'une société mais sont aussi les levains d'actions et de comportements susceptibles de modifier les cadres de vie de nos sociétés.

05 LES INQUIÉTUDES ET LES RISQUES DE LA POLLUTION DOMESTIQUE, RECENSÉS DANS UN CENTRE ANTI-POISONS, A PROPOS DE 329 INCIDENTS EN 1 AN

G. Riboulet-Delmas, R. Garnier & M.L. Efthymiou (Centre Anti-Poisons, Paris, France)

Si les médecins traitants constatent la pathologie liée à la pollution domestique, les centres anti poisons recueillent les cas de contamination aussi bien sans conséquences médicales que celles comportant des troubles;leur mode de recrutement représente un autre mode de connaissance des produits source de pollution chimique domestique.

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Les statistiques du Centre anti poisons de Paris, CAPP, en représentent une illustration En 1987, le CAPP a reçu 509 demandes concernant un incident de pollution, soit 0,9% de son activité globale; les cas de pollution dans la maison au sens strict sont au nombre de 329, soit 64,6% du collectif, malgré les pollutions par produits phyto-sanitaires, par accident de la circulation et déversement de produits chimiques transportés, les contaminations d'eau potable....

Le principal responsable est le monoxyde de carbone, en particulier par l'emploi de chauffe eaux mal réglés;les incendies libérant des gaz caustiques et des cyanures sont une autres cause non négligeable de pollution domestique.

Il est aussi intéressant de comparer les sources de pollution dans la maison à celles survenant dans des locaux assimilables: crèches et écoles, hôpitaux.

O6 LE MONOXIDE DE CARBONE: ÉPIDEMIOLOGIE ET PRÉVENTION DES INTOXICATIONS AIGUES DANS L'AGGLOMÉRATION BRUXELLOISE

B. Tissot, N. Tinan** & M. Govaerts* (*Centre antipoisons, Bruxelles & **Cultures et Santé, Bruxelles, Belgique)*

Les mesures d'économie d'énergie, de plus en plus largement répandues, posent, de par la réduction de circulation d'air dans les locaux qu'elles provoquent, le problème de la pollution intérieure. Dans ce travail, nous nous sommes limitées à l'étude des intoxications aigues à l'oxyde de carbone, vu leur fréquence et leur gravité.

Une analyse épidémiologique approfondie a été menée dans l'agglomération bruxelloise, mettant en lumière une corrélation étroite entre certains paramètres et le risque d'accident. Suite à cela, nous avons mis en place une stratégie de prévention multicentrique et multimedia impliquant différents intermédiaires.

Un bilan de ces interventions ainsi que les perspectives d'avenir seront détaillés.

O7 ETAT ACTUEL DES RECHERCHES EN MATIERE DE QUALITÉ DE L'AIR A L'INTÉRIEUR DES LOCAUX

J.C. Loewenstein (Electricité de France, Direction des Etudes et Recherches, Chatou, France)

La pollution intérieure des locaux est caractérisée par l'existence de nombreux types de polluants tels que: radon, fumée de tabac, aéroallergènes, micro-organismes, gaz de combustion, produits organiques, fibres et particules. Ils proviennent de 4 grandes catégories de sources: l'air extérieur, les matériaux et les systèmes collectifs, les produits de combustion, les êtres vivants et l'activité. La question des inventaires relatifs à ces problèmes est capitale, de même que le développement d'une métrologie adaptée.

La ventilation, le traitement d'air et les facteurs climatiques doivent faire l'objet d'une attention particulière. L'étanchéité et le taux de renouvellement d'air sont des facteurs d'une grande importance sur la qualité de l'air intérieur, aussi bien en matière de confort que de pollution.

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Les conséquences de la pollution intérieure sur la santé dépendent naturellement beaucoup des polluants. Il reste encore beaucoup à faire dans ce domaine.

Deux autres secteurs méritent également de nombreux développements: les techniques de maîtrise et/ou d'élimination des pollutions intérieures; et la question des normes et réglementations pour laquelle on assiste actuellement, à une intense activité.

O8 RADON AND LUNG CANCER: A CASE-CONTROL STUDY IN SOUTHERN BELGIUM

A. Poffijn, R. Mak, J. Prignot**, M. Vanhoorne & P. Weynants** (Department of Hygiene and Social Medicine & *Laboratory of Physics, Ghent State University, **Mont Godinne Hospital, Department of Pneumology, Catholic University of Louvain, Belgium)*

Indoor radon is the most important source of exposure to ionising radiation for the population.

Risk assessment for low dose radiation still is a matter of controversy. Raised exposure to radon leads to a higher risk for lung cancer in uranium miners. Animal experiments also show a relation between high radon exposure and lung cancer.

The work hypothesis of our study is based on the extrapolation of these data raised exposure to indoor radon is one of the causal factors of lung cancer. The etiologic fraction is estimated to lie between 10% and 30%.

About 6000 people in Belgium die of lung cancer each year.

A part of these lung cancers that may be causally associated with indoor radon exposure (600), may be prevented by technical, often simple measures in housing construction.

Indoor radon levels are measured by the track-etch detector method in a group of people with lung cancer and in a comparable group of people without lung cancer.

The prevalence in both groups of all other factors possibly associated with lung cancer is assessed by means of a standardised questionnaire.

We will present some preliminary results of the pilot study, in which 50 cases and 100 controls entered. The odds ratio for radon exposure for all subjects was 2.7. For smokers it was 4.0.

O9 INDOOR RADON IN BELGIUM

A. Poffijn & H. Vanmarcke (Laboratory of Physics & Laboratory of Nuclear Physics, Ghent State University, Belgium)

In a general survey, radon measurements were performed in some 300 dwellings. The population average indoor radon concentration was found to be 53 Bq/m^3.

The geological difference between the southern paleozoic zone and the northern, mainly sedimentary zone was found back in difference in the corresponding regional mean radon values of 77 Bq/m^3 and 44 Bq/m^3.

The influence of uranium in soil on indoor radon was studied in more detail in a local study in two neighbouring villages. The year average of 117 Bq/m^3 obtained from seasonal measurements in some 50 houses in the village situated partly on an uranium anomaly is significantly higher than the value of 80 Bq/m^3 found in the adjacent reference village.

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O10 RADON DYNAMICS IN AN UNHEATED HOUSE

D. Furrer, R. Crameri & W. Burkart (Radiation Hygiene Division, Paul Scherrer Institute, Villigen, Switzerland)

Environmental parameters such as temperature, wind speed, wind direction and humidity as well as house specific parameters such as indoor temperature, air exchange rates, basement structure and vertical air flows between the floors provide the driving forces and conditions for the radon entry into the living area.

This contribution presents field data describing the influence of the indoor-outdoor temperature gradient which induces airflow up the staircase and by this a transport of radon rich air from the cellar to the higher floors.

The velocity of the airflow was about 0.1 ms^{-1} when the indoor-outdoor temperature difference increased to more than zero. At temperature differences equal or lower then zero the airflow up the staircase was not detectable. Correlations between airflow and radon concentrations showed, that about 15 $kBqh^{-1}$ of radon gas was transported up the staircase by a volume flow of about 20 m^3h^{-1}.

Correlations of the time-course of the radon concentration with the diurnal fluctuations of either the temperature gradient and the pressure differences outdoor-indoor or soil-indoor were reproducible over the whole measurement period. We conclude that the major part of the radon infiltration into this specific house is due to the thermal gradient. Understanding the various mechanisms influencing radon entry into buildings is an important aid in the design of efficient mitigation strategies.

O11 TABAGISME & SANTÉ: LE CAS DE LA FRANCE

A. Hirsch (Service de Pneumologie, Hôpital St. Louis, Paris, France)

Les cultures du tabac, principalement dans le Sud-Ouest et dans l'Est du pays, occupent environ 15 000 hectares, et emploient environ 18 000 planteurs. La fabrication des produits de tabac est assurée en France exclusivement par la SEITA (Société d'Exploitation Industrielle des Tabacs et Allumettes), qui emploie environ 7 000 personnes. La distribution est effectuée par l'intermédiaire de 40 000 débitants, dépendant de la Direction Générale des Impôts. Depuis 1971, la SEITA a perdu le monopole du commerce de gros des tabacs, et actuellement les producteurs européens et internationaux ont pris plus de 40% des ventes du marché national.

Le prix de vente au détail des cigarettes, inclus dans la liste des produits intervenus dans l'indice général des prix, est maintenu à un taux très inférieur à celui pratiqué dans les états membres de la Communauté Européenne. Après la Grèce, le prix moyen de vente de la cigarette en France est le meilleur marché dans l'Europe des 12. 75% du prix de vente des cigarettes représentent les taxes qui ont rapporté à l'Etat français environ 23 milliards de francs en 1985, ce qui représente environ 2,5% des recettes fiscales de l'Etat. Ce chiffre doit être à rapprocher de l'estimation des coûts sanitaires liés au tabagisme, évalués entre 45 et 60 milliards de francs en 1985.

Appréciée sur une longue période, la consommation globale de tabac mesurée sur les statistiques nationales de vente est en très forte progression en France moins de 3 cigarettes vendues par adulte (15 ans et plus) et par jour en 1950, 6 en 1985. Les résultats des sondages sont en contradiction avec cette tendance ils indiquent 59% de fumeurs dans la population adulte en 1953, et 38% en 1986. Ceci s'explique en partie d'une part par la forte progression du nombre de cigarettes consommées par fumeur (20% d'hommes fument 20 cigarettes ou plus par jour en 1983 contre 10% en 1973), d'autre part par une sous déclaration de l'habitude de fumer lors des sondages. Le début du tabagisme est de plus en plus précoce. En 1984, on relève 12% de fumeurs

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entre 12 ans et 13 ans, plus de 50% entre 16 ans et 17 ans, 66% à 18 ans. D'autre part, contrairement à ce que l'on observe à l'âge adulte, la répartition des fumeurs à l'adolescence se répartit également dans les deux sexes. Le nombre de cigarettes fumées par jour progresse parallèlement avec l'âge moins de la moité des fumeurs de 12–13 ans sont des fumeurs réguliers, 80 à 90% des fumeurs de 18 ans le sont. Enfin, l'arrêt du tabagisme apparait de plus en plus précoce 20% d'ex-fumeurs à 30 ans, 50% après 65 ans.

Ces caractéristiques de la consommation de tabac en France, compte tenu de la longueur de la période de développement des maladies liées au tabac, et de l'importance de l'âge de début du tabagisme notamment dans le cas du cancer du poumon, apparaissent très préoccupantes pour l'avenir. Dès à présent, la mortalité liée au tabac est considérable : 54 000 décès en 1982, représentant 10% de la mortalité annuelle. La cause de ces décès se répartit ainsi 32 000 décès par cancers (poumons, voies aérodigestives supérieures, vessie), 11 000 décès par maladies cardio-vasculaires (maladie coronarienne, accidents vasculaires cérébraux, anévrismes de l'aorte), 6 000 décès par maladies respiratoires chroniques (bronchite chronique, emphysème) et 5 000 décès de causes diverses. Ainsi, l'usage du tabac vient-il en tête des causes connues de cancers, les cancers ayant été responsables en 1978 de plus de 35% de la totalité des morts masculines. Les morts par cancers sont la première cause de mortalité prématurée chez l'homme, entre 45 et 69 ans, et se situe bien avant la mortalité par maladies cardio-vasculaires. Cette part attribuable au tabac des décès par cancer, qui était de 25% en 1982, pourrait dépasser 30% à la fin du siècle si aucune mesure efficace n'est prise pour enrayer l'épidémie de tabagisme.

L'âge de plus en plus précoce des fumeurs, le taux élevé des goudrons cancérogènes en France, 16,5 mg en moyenne par cigarette en 1987, l'augmentation de la consommation globale et l'augmentation du nombre des gros fumeurs représentent des facteurs devant faire redouter un accroissement de la mortalité par cancers liés au tabac en France dans les vingt prochaines années.

Par ailleurs, l'existence d'un risque lié à l'exposition passive involontaire à la fumée de tabac est indiscutable: infections respiratoires aiguës des enfants de parent(s) fumeur(s), effet du tabagisme sur le foetus lors de la grossesse (réduction pondérale), excès du risque de cancer du poumon et de troubles respiratoires fonctionnels chez les non fumeurs vivant avec un conjoint fumeur. Cette évolution dramatique n'est pas inéluctable: au Royaume Uni, aux Etats-Unis, en Scandinavie et en Finlande, une politique de lutte contre le tabagisme a été instituée dans les années 60, et dans ces pays on enregistre dès à présent une stabilisation de la progression des cancers liés au tabac. Ceci est obtenu d'une part par l'arrêt de l'augmentation de la consommation globale de tabac dans ces pays, d'autre part, par la réduction de la concentration en goudrons cancérogènes dans les cigarettes qui y sont consommées. La charte proposée par l'Organisation Mondiale de la Santé à la Première Conférence Européenne de Madrid sur les politiques concernant le tabac (Novembre 1988), qui propose le droit à respirer un air dépourvu de fumée, constitue un outil susceptible d'aider à enrayer cette terrible menace pour la santé publique.

O12 ENVIRONMENTAL TOBACCO SMOKE AND LUNG CANCER: IS IT THE SMOKE OR THE DIET?

L.C. Koo (Department of Community Medicine, Medical Faculty, University of Hong-Kong)

Worldwide epidemiological studies on the association of environmental tobacco smoke (ETS) and lung cancer in non-smokers have produced controversial results. In some ways, the Chinese female population in Hong Kong is an ideal place to study this question because of their high

Source: https://www.industrydocuments.ucsf.edu/docs/lqdl0000

rates of lung cancer and chronic bronchitis unrelated to a history of active smoking.

To elucidate the possible contributory role of air pollutants to lung cancer etiology, the following have been investigated in Hong Kong: recalled lifetime exposure levels to ETS and types of cooking fuels; urinary levels of cotinine and hydroxyproline adjusted for creatinine; personal exposures to nitrogen dioxide; and levels of polycyclic aromatic hydrocarbons and airborne bacteria and fungi in the indoor air of homes. None of the results have produced, clear evidence linking such exposure to risk for lung cancer or chronic bronchitis among non-smokers.

On the other hand, the role of diet was consistent in increasing the risk for lung cancer in never-smokers. Those who consumed fresh fruits and vegetables more frequently, and smoked/cured meats, pickled vegetables and alcohol less frequently, were at reduced risk for lung cancer. Moreover, non-smoking wives with non-smoking husbands were more likely to eat the better diet than those with smoking husbands, and there is some evidence linking reduced risk for chronic bronchitis with the better diet. Thus the possibility of ingestants overshadowing the role of inhalants in the controversy of ETS and lung cancer needs further consideration.

O13 DIETARY HABITS ARE OF LIMITED IMPORTANCE IN INFLUENCING THE LUNG CANCER RISK AMONG JAPANESE FEMALES WHO NEVER SMOKED

T. Hirayama (Institute of Preventive Oncology, Japan)

Statistically significant effects of diet on lung cancer risk were reported by L.C. Koo in non-smoking females in Hong Kong (Nutrition and Cancer, 11(3):155–172, 1988). Observation on 303 lung cancer death in non-smoking women in our large scale cohort study in Japan (1966–81), however, were not in line with her report.

Age standardized lung cancer mortality rates per 100,000 in non-smoking women in daily consumers and not daily consumers for fish were 19.75, 17.11 (two sided $p = 0.169$) meat, 19.25, 17.98 ($p = 0.766$) green-yellow vegetables, 17.51, 19.74 ($p = 0.352$) soybean paste soup, 18.57, 16.94 ($p = 0.474$) alcohol, 12.64, 18.00 ($p = 0.699$).

Next, in order to study possible confounding influence of dietary habits on the effects of husbands smoking on lung cancer risk in non-smoking wives, proportion of daily consumers was compared among lung cancer cases in non-smoking women with non-smoking husbands, husbands previously smoked or currently smoking 1–19 cigarettes daily, and husbands smoking 20 or more cigarettes daily. No significant trend was observed with any food: rice (two sided p for trend = 0.383) meat ($p = 0.557$), fish ($p = 0.059$), milk ($p = 0.823$), green-yellow vegetables ($p = 0.353$), pickles ($p = 0.582$), soybean paste soup ($p = 0.184$). The positive association of borderline significance with daily fish consumption might be of some importance. However statistically significant dose response relationship between the lung cancer risk in non-smoking wives and amount of husbands smoking was clearly observed when frequency of fish consumption was adjusted, lung cancer relative risk in non-smoking wives with non-smoking husbands, husbands previously smoked or currently smoking 1–19 cigarettes daily and husbands smoking 20 or more cigarettes daily being 1.000, 1.517, 1.984 (Mantel extension chi 2.357, one tails p value 0.00921).

In conclusion dietary habits are of limited importance, if any, in influencing the risk of lung cancer in non-smoking women as a whole and also in relation to the amount of husbands smoking in Japan.

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O14 AN EXAMPLE OF EXTRA-POISSON VARIATION SUGGESTING AN UNDERSPECIFIED MODEL

S.J. Kilpatrick, Jr. (Virginia Commonwealth University, USA)

It has been pointed out that it is unclear if Hirayama's analysis of his record linkage study (1) used the ages of the husbands to adjust the lung cancer mortality of his non-smoking wives (2).

Dr. Hirayama subsequently tabulated the lung cancer mortality of these women by their own ages (3) and concludes that passive smoking is a promoter for lung cancer.

Recently, following Breslow (4), a model allowing for extra-Poisson variation was applied to Table 2 of (3). This analysis shows that exposure to environmental tobacco smoke is *not* statistically significant (at the 5% level). Thus, under this model, the relative risks for the wives of moderate and heavy smokers are estimated as 1.11 and 1.48, neither of which are significantly different from 1.0. The 'dose-response' relationship is likewise not statistically significant.

This finding demonstrates how one can be misled if standardization by the age of the spouse is used rather than the subject's own age. The presence of extra-Poisson variation indicates that Hirayama's analyses are incomplete in not accounting for variation in person years as well as omitting period, cohort and other effects confounded with exposure to environmental tobacco smoke.

1. Hirayama T Br. Med. J. 282, 183–185 Jan. 17, 1981.
2. Harris, JE & Du Mouchel WH Br. Med. J. 283, 915–916, 3 Oct. 1981.
3. Hirayama T Ch. 14 (p. 175–195) of Lung Cancer: Causes and Prevention Mizell M & Correa P (eds.) Verlag Chemie Int. 1984.
4. Breslow NE J. Roy. Stat. Soc., C 33, 1, 38–43, 1984.

O15 LUNG CANCER RISK BY ORAL EXPOSURE

R. Rylander & N.J. Haussmann (Department of Environmental Hygiene, University of Gothenburg, Sweden & *Institute of Biological Research, Cologne, F.R. Germany)*

In studies on the etiology of lung cancer, the traditional approach has been to investigate the presence of airborne agents which by inhalation expose the respiratory epithelium or alveoli to potentially carcinogenic agents. Evidence from toxicology during recent years has however demonstrated that substances taken up by the oral route may result in pulmonary exposure to potential carcinogens. The microbiological flora in the gut has the capacity to metabolize substances. An example of such metabolism is the formation of nitrosamines by nitrates and amines from food which may later accumulate in the lung. Agents taken by the oral route may be distributed to the lung and metabolized locally in the lung. An example of this is the uptake of dibromethane which is metabolized in the lung epithelium.

The presentation reviews the above toxicological pathways and suggests agents which are ingested and should be controlled for in studies on lung cancer associated with indoor air exposure.

Source: https://www.industrydocuments.ucsf.edu/docs/lqdl0000

O16 PASSIVE SMOKING ACUTE EFFECTS ON LUNG FUNCTION OF SENSITIVE PERSONS

B. Danuser, A. Weber & L. Hartmann (Inst. für Hygiene und Arbeitsphysiologie, Swiss Federal Inst. Technology, Zurich & *Allergiestation der Dermatologischen Universitätsklinik, Zurich, Switzerland)*

Cigarette sidestream smoke is one of the major indoor air pollutants.

To investigate the acute effects on lung function a sidestream smoke provocation test analogous to a nonspecific bronchial provocation test was performed with 10 hyperreactive (5 subjects with bronchial asthma, 4 with asthmatic bronchitis, 1 with chronic sinusitis) and 10 non-hyperreactive, healthy subjects. All were non-smokers.

Sidestream smoke generated by a cigarette smoking machine (located outside the chamber, not visible to the subject) was trapped and diluted with fresh air to gain different concentrations characterised by carbon monoxide (0, 2, 4, 8, 16, 32 ppm CO). Additionally the respirable particulate matter was measured.

On a first day the subjects underwent a bronchial provocation test with Methacholin. On a second day (1–4 days apart) the subjects inhaled each sidestream smoke concentration for 2 minutes with a noseclipse. After each exposure maximum flow volume curves were registered and subjective symptoms of irritation were evaluated by a rating scale.

The lung function of the healthy subjects was not altered by the inhalation of sidestream smoke. In hyperreactive subjects the inhalation of sidestream smoke produced a decrease in FEV1, FVC and FEF50. The decrease was most pronounced after the lowest dose (2 ppm CO), with a mean decrease of 6% in FEV1. On the other hand the total mean decrease of FEV1 did not exceed 10% even after the highest dose (32 ppm CO).

We conclude that even short exposure to low concentrations of cigarette sidestream smoke causes decrements of lung function in hyperreactive subjects.

O17 EVALUATION DE L'EXPOSITION A UN ENVIRONNEMENT: QUELQUES EXEMPLES CONCRETS RELATIFS A L'UTILITE DES INDICATEURS ATMOSPHERIQUES ET BIOLOGIQUES

A.M. Laurent, Y. Courtois, S. Prelet, J.R. Claude & B. Festy (Laboratoire d'Hygiène de la Ville de Paris, France)

L'exposition active ou passive à la fumée de tabac peut être évaluée par la détermination dans les milieux biologiques de différents marqueurs permettant d'apprécier l'imprégnation tabagique et les capacités de métabolisation ou de détoxification de l'organisme: monoxyde de carbone (CO) dans l'air alvéolaire – carboxyhémoglobuline (COHb), nicotine et métabolites, thiocyanates (SCN) dans le sang – nicotine et métabolites, SCN thioéthers, mutagènes dans les urines. La cinétique d'élimination de ces métabolites urinaires a été étudiée, dans des conditions bien définies, chez 2 sujets fumeurs par référence à de non fumeurs.

Les indicateurs biologiques permettent de différencier significativement les sujets fumeurs des non fumeurs. Par contre, la distinction entre les individus non exposés et ceux exposés passivement à la fumée de tabac n'est pas aisée. Dans le but d'évaluer l'impact sanitaire d'un environnement tabagique subi involontairement par des sujets non fumeurs, le LHVP a participé, en collaboration avec des équipes universitaires et médicales, à deux enquêtes épidémiologiques.

L'idéal serait d'associer à des déterminations de biomarqueurs d'exposition tabagique des

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mesures atmosphériques dans les principaux microenvironnements fréquentés par les individus. Une expérience réalisée au laboratoire a confirmé les indicateurs majeurs permettant de caractériser une atmosphère enfumée: nicotine, particules fines en suspension, ammoniac, aldéhydes et CO.

O18 EXPOSURE TO ENVIRONMENTAL TOBACCO SMOKE IN THE NON INDUSTRIAL WORKPLACE UNDER DIFFERENT CONDITIONS OF VENTILATION AND SMOKING REGULATION

T.D. Sterling, C.W. Collett & J.A. Ross** (Faculty of Applied Sciences, School of Computing Science, Simon Fraser University, Burnaby, Vancouver & *Theodor D. Sterling & Associates, Vancouver, Canada)*

Regulations of smoking differ, ranging from complete prohibition; to designating separate smoking and nonsmoking areas that may or may not be separately ventilated; to local arrangements among smokers and nonsmokers and nonsmokers on the workroom floor. For many purposes of building design and of ventilation, the level of exposures to nonsmokers that may be expected under different conditions of building design, ventilation, and regulation needs to be known.

A number of field studies designed to provide data on ETS levels under various conditions and especially (1) on the contribution of smoking to indoor levels of substances usually related with smoking (such as CO, CO_2, RSP and nicotine), and (2) on how the restriction of smoking to designated but not separately ventilated areas, affects the level of ETS in nonsmoking offices. Data were collected from smoking and nonsmoking sections of designated smoking lounges or cafeterias, from separate smoking and nonsmoking lounges, and from offices in which there is ad lib smoking or no smoking at all. In some of these nonsmoking work areas, air is recirculated from specially designated smoking areas.

Results show the extent of dilution of ETS under normal conditions of occupation and ventilation. Nicotine levels in nonsmoking offices or lounges which receive recirculated air from a designated smoking area are below or close to the detection limit of analytic procedures. There are no substantial differences in RSP, CO or CO_2 concentrations between nonsmoking offices that receive recirculated air from smoking areas and those who do not receive recirculated air.

O19 PASSIVE SMOKING AND LUNG CANCER. FACT OR FICTION?

P. Lee (PN Lee Statistics and Computing Ltd, United Kingdom)

An overview of epidemiological evidence on lung cancer in non-smokers suggests superficially that those married to smokers have a 20–50% greater risk than those married to non-smokers. Rearing in mind the minute amounts of particulate matter retained by non-smokers exposed to ETS – probably of the order of 1/5000th that retained by active smokers – this increase seems surprisingly large. Although large, when viewed in this context, the increase is certainly small enough to have arisen wholly, or virtually wholly, as a result of one or more of the various

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sources of bias typically present in epidemiological studies. Publication bias, caused by failure to present findings from negative studies, is one possible source. Recall bias is another possible source in case-control studies. The most relevant source, however, is likely to be bias caused by contamination of the non-smokers by a small percentage of misclassified smokers. Because smokers have high lung cancer risk and because there is a strong tendency for smokers to marry smokers, the contamination rate among self-reported non-smokers will be higher in those married to smokers than in those married to non-smokers. Two types of contamination are relevant, failure to report current smoking and failure to report past smoking. A review of the evidence on the extent of both types of contamination indicates they are large enough to cause a level of bias similar in magnitude to the 20–50% increase in lung cancer risk observed epidemiologically. The answer to the question posed in the title of this paper may well be "wholly or predominantly fiction."

O20 Title to be communicated

D. Trichopoulos (University of Athens, Greece)

O21 INITIATIVES TAKEN WITHIN PARENTS IN SCHOOL TO REDUCE PASSIVE SMOKING RISKS

C. Arciti, B. Doglio & L. Santi (Istituto Nazionale per la Ricerca sul Cancro, Genova, Italy)

Environmental pollution caused by smoking is becoming an increasingly serious problem particularly as regards the dangers passive smokers are subjected to. An antismoking program has been in force in Liguria for many years directed at the young to try to prevent their starting the habit as well as at teachers and parents so that they cut down or stop smoking. The program carefully monitored for a number of years has provided positive results with the young both as regards the number of young people who quit smoking after having participated in the program (30%) as well as the small number of those who started (3%). Prevention of the harm caused by passive smoke is aimed in particular at parents of primary school children and those with young children in pediatric hospitals. 600 questionnaires were handed out during parent-teacher meetings at school and a second one after 6 months. The questionnaires were distributed to all participants of which 30% were not smokers. So far data has been processed for 434 parents of which 20% only were aware of the problem; 60% of mothers and 85% of fathers were accustomed to smoke in the presence of their children. After 6 months the questionnaire was again distributed to check the usefulness of the information given. 2 groups of parents were controlled, similar for age and social class one of which had taken part in the sensibilization

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meeting while the other had filled in the questionnaire only. In the group already sensibilized, 44% cut down, 23% tried to quit, 13% quit so as not to harm their children. In the follow up controls, 84% continued to smoke, 18% had cut down and 3% had quit. in the pediatric hospitals a sensibilization has only just begun. Questionnaires requesting information on smoking habits are distributed to parents of children under 12 in hospital for respiratory tract illnesses. Tests are effected on the children to check it they are passive smokers, conferences organized and informative material distributed on the damages caused by an environment polluted by smoke.

O22 ENVIRONMENTAL TOBACCO SMOKE AND LUNG CANCER

E.L. Wynder (American Health Foundation, USA)

This presentation will review the current evidence on the linkage between passive inhalation of tobacco smoke and lung cancer. From a biological point of view it is plausible that such a relationship is, in fact, a real one. Epidemiological evidence will be reviewed and as it relates to the consistency within and between studies. Possible artifacts will be discussed as it relates to biases and confounders. Finally, additional epidemiological studies will be suggested that could further elucidate the possible causative association between environmental tobacco smoke and lung cancer.

O23 INDUCTION OF LIVER AND LUNG MICROSOMAL MONO-OXYGENASES BY A TOBACCO SMOKE

V.V. Khudoley (N.N. Petrov Research Institute of Oncology, Leningrad, USSR)

The aim of the present study consisted in a comparative evaluation of a tobacco smoke (TS) metabolic activation and induction of microsomal monooxygenases by the latter.

The rats (white, outbred females, 160–200 g b.w.) were kept in a 20-litre plastic chamber, which was filled with a TS from one filter cigarette ("Rodopi" trade mark) "smoked" with the help of a syringe (V = 20 cm^3). The general volume of TS was 400–440 cm^3, and exposure – 60 min. Six hours later, microsomal fractions (MF) were prepared from livers and lungs of these animals, as well as from rats pretreated (5 days prior sacrifice) with a well-known inductor Aroclor-1254 (500 mg/kg b.w.). In dissecator modification of the Ames assay with the employed *Salmonella typhimurium* TA98, the mutagenic effect of TS (the exposure of plates being 5–15 min) was established. The latter was expressed in statistical prevalence of incidence of his^+ – revertants under spontaneous level of mutations. In the presences liver MF from aroclor-treated rats, the mutations rate increased 5–7 times, and lung MF was 4–4.5-fold. The use of liver MF from TS-treated animals lead to a 3-fold mutation increase, and lung MF – to a 6–8 mutation increase. Aroclor pretreatment resulted in a 16-fold increase of arylhydrocarbonhydroxylase activity in the lung and a 20-fold increase in the liver, while a TS exposure led to a 4-fold and 8-fold increase, respectively.

The results obtained evidence mutagenicity of TS and the presence of agents in it inducing cytochrom P-450-dependent microsomal monooxygenases system.

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O24 ISOPRENE – A POTENTIAL INDOOR INDICATOR FOR ENVIRONMENTAL TOBACCO SMOKE

G. Löfroth (Nordic School of Public Health, Gothenburg, Sweden)

It has been suggested that the alkadiene isoprene (2-methyl-1,3-butadiene) may be used as an indicator for environmental tobacco smoke (ETS) as it is a major component of sidestream cigarette smoke and ETS (Löfroth et al., Env. Sci. Technol., in press) and as it is only present elsewhere in relatively low concentrations originating from other sources. The present study aimed at evaluating a portable gas chromatographic instrument (Photovac 10S50, Photovac Inc., Canada) for routine isoprene analysis and at the determination of isoprene emission from some pyrolysis processes. The analyses were performed with the use of the backflush technique with an instrument equipped with a 6" x 1/8" precolumn and a 4' x 1/8" major SE30 column. It was possible to detect air concentrations down to 10 ppb isoprene (28 µg/cu.m) and further optimization may enhance the detection level to still lower concentrations. Ambient outdoor air (Gothenburg, November 1988) did not contain detectable isoprene concentrations (<10 ppb) but slightly higher and detectable concentrations are probably present during the vegetational growth seasons.

The emission of isoprene in sidestream cigarette smoke, produced by machine smoking, was confirmed to be 4–5 mg per g tobacco burnt, resulting in indoor concentrations well above the detection level at normal smoking and ventilation rates. A number of other indoor pyrolysis processes were also investigated and were found to emit considerably less or no isoprene compared to tobacco smoking. Items investigated were, in order of decreasing amounts of isoprene per g material: a non-tobacco herbal cigarette brand, an insecticidal pyrethrin pyrolysis spiral, one type of incense sticks, the so-called smokeless cigarette (Premier, R.J. Reynolds Tobacco Co., USA) and pork frying. The emission of carbon monoxide, benzene and particulate matter was also measured for these processes as well as for tobacco smoking.

Human breath is known to contain isoprene but its endogenous origin is unknown. Exhaled breath from six non-smoking volunteers contained on the average 216 ppb (min. 189, max. 255). Two smokers exhaled 420 and 510 ppb indicating that they had an additional reservoir of isoprene due to active smoking. These breath concentrations, resulting in an emission of approximately 300-400 µg per person and h, will not significantly influence isoprene measurements in smoking environments with normal occupancy.

It is concluded that isoprene may be used for the detection of ETS but the presence of other sources such as vegetation and people as well as some less common pyrolysis processes should always be considered to cause a low background isoprene concentration.

O25 THE PASSIVE SMOKING MYTH

N. Mantel (The American University, Washington, D.C., U.S.A.)

While environmental tobacco smoke is offensive to a large portion of the non-smoking public, there is no clear evidence of any ill effects on health. With minimal allowance for bias in reports made, it is unlikely that any resulting increase in lung cancer exceeds 10%, too low for detection in a case-control or other epidemiological study and readily explicable by as yet unconsidered or unknown biases.

Though enormous increases in ischemic heart disease mortality have been attributed to passive smoking, this was a result of a computational error – the actual data did not support the finding. More moderate, but yet not statistically significant increases in heart disease deaths, heart disease events, or deaths from any cause were reported for men who had never smoked but who had smoking wives. At an international conference, these were nevertheless stated to be significant findings. That non-smoking men had smoking wives would suggest the families were atypical, with atypical dietary habits. Also, a never-smoker man could be indicative of an "unhealthy non-smoker effect," with men who had never smoked including individuals who, for health or other medical reasons, could not smoke.

The author draws on his wide range of experience in other fields to illustrate other concepts, biases, calculating errors, statistics gone awry, the favoring of work and the publication of articles on the "right" side of an issue.

O26 RELATIVE LUNG CANCER RISK FROM EXPOSURE TO MAINSTREAM AND SIDESTREAM SMOKE

J.J. McAughey, J.N. Pritchard & A. Black (Environmental & Medical Sciences Division, Harwell Laboratory, Oxon, United Kingdom)

There has been increasing public concern as to the potential health effects of environmental tobacco smoke (ETS), particularly lung cancer, with the publication of recent reports such as that of the U.S. Surgeon General. Much work has been reported on the use of biological markers to quantify exposure to ETS relative to levels in smokers. However, these markers, based on carbon monoxide or nicotine exposure, cannot be directly related to the deposition and retention of tar particles, which are presumed to contain the carcinogenic agents. Models of the estimation of relative risk from exposure to mainstream (MS) and sidestream (SS) smoke particulates must take account of the deposition efficiency, regional deposition and clearance of the smoke components. In this paper we shall consider the mass of particulate deposited in the tracheobronchial region of the lung, the predominant site of lung cancer in humans. Mainstream tar deposition in smokers has been measured directly using a radiolabel, ^{123}I-1-iodohexadecane, and the TB fraction obtained from differential lung clearance. Daily TB deposition of tar averaged 260 mg in 23 male U.K. middle-tar smokers. For sidestream smoke, experiments were carried out in an environmentally controlled chamber (14 m^3) giving an equilibrium SS particulate concentration of 0.9 mg/m^3 for 2 cigarettes burning continuously at 10 air changes per hour, a concentration typical of mean values of ETS found in various indoor air sampling surveys. Daily TB deposition of tar is calculated to be 0.045 mg assuming an 8 hour workplace exposure and 10% lung retention split in the ratio 10TB:90P, as observed for inert particles of 0.2 µm mean diameter. This gives a TB deposition factor of 0.00018 relative to smokers. Assuming a linear no-threshold hypothesis, this would suggest that occupational exposure to ETS may account for 16 of the 40,000 lung cancer deaths per year in the U.K. It should be noted, however, that this model takes no account of the behaviour of individual smoke constituents or vapour deposition. This may be important, particularly for sidestream smoke, as experimental work has shown up to 70% of SS particles by mass evaporate as aging occurs, and vapour deposition is especially compound specific.

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O27 EXPOSURE TO ETS AND ITS BIOLOGICAL EFFECTS

F.X. Adlkofer, G. Scherer, L. Von Meyerinck, Ch. Von Maltzan & L. Jarczyk (Forschungsgesellschaft Rauchen und Gesundheit mbH, Hamburg, F.R. Germany)

The table shows the amounts of some of the main volatile and particle bound substances inhaled by smokers and passive smokers, based on the different retention rates.

	Smoking (20 cig/day)	Passive Smoking (8h/day)	Ratio (Smoking/Passive Smoking)
CO (mg)	40 – 400	14.4 – 96	2.7 – 4.2
Formaldehyde (mg)	0.4 – 1.8	0.08 – 0.4	4 – 5
VNA (µg)	0.05 – 1.0	0.03 – 0.4	1.5 – 2.5
Nicotine (mg)	10 – 40	0.08 – 0.4	100 – 125
Particles (mg)	100 – 400	0.024 – 0.24	1,700 – 4,000
TSNA (µg)	6 – 60	0.002 – 0.01	3,000 – 6,000
BaP (µg)	0.2 – 1.0	0.001 – 0.011	90 – 200
Cadmium (µg)	2	0.001 – 0.014	143 – 2,000

It is obvious that considerable problems exist in attempting to extrapolate the health risk of passive smoking on the basis of the risk generally associated with smoking. COHb, urinary cotinine and thioether excretion increased in relation to the dose. Neither urinary hydroxyphenanthrene excretion nor urinary mutagenicity were found to increase. In a recently terminated 90-day-pilot study of animals no histopathological changes could be seen by light microscopy, except for minor changes in the nasal dorsal area of the animals, which were found to recede after the end of the treatment. This is in contrast to the results obtained with diesel exhaust.

In conclusion, our data demonstrate that the uptake of ETS and its effects on biological systems are different from those found after active smoking. This is not only due to the different concentration and distribution of ETS in the lung, but also to its composition. In ETS, substances of the gaseous phase may be more important than particle bound substances, which is in contrast to the mainstream smoke inhaled by smokers. In view of the fact that no genotoxic effects of passive smoking on the human organism have been demonstrated so far, the question arises, whether passive smoking represents a real cancer risk at all. At present no data are available, which would permit a sound risk evaluation.

O28 CARBONYL COMPOUNDS IN MAINSTREAM AND SIDESTREAM CIGARETTE SMOKE

H. Schlitt & H. Knöppel (Commission of the European Communities, Joint Research Centre, Environment Institute, Ispra, Italy)

In view of the important role of environmental cigarette smoke as an indoor pollution source on one side and on the other side of the strong irritation potential of many carbonyl compounds as well as the mutagenic properties of several of them we have applied a specific analytical method to the selective detection of carbonyl compounds in mainstream (MS) and sidestream (SS) or environmental cigarette smoke.

The study consists of two parts. In *part A* carbonyl compounds in MS smoke of 34 cigarette brands available on the Italian market have been determined. Acetaldehyde is the most prominent carbonyl compound in cigarette smoke accounting for 57 ± 15 % of the total and is a good indicator of smoking in an indoor environment. All but one of the 10 aldehydes and 4 ketones which have been identified are known irritants. In addition the delivery of carbonyl compounds as a function of the number of puffs has been measured for a cigarette with and without filter. Concentrations of carbonyl compounds in MS smoke increase exponentially with the puff number.

In *part B* carbonyl compounds in MS smoke have been compared with those in SS (or environmental) smoke for cigarettes with and without filter. Both cigarette types release comparable amounts of carbonyl compounds to sidestream smoke, i.e. to the environment These amounts are under standard smoking conditions (35 mL/puff, 1 puff/min) from 4 to 500 times higher than those delivered to MS smoke, i.e. to the smoker, depending on the compound and cigarette type. In addition the influence of the air velocity on these quantities has been determined.

O29 NICOTINE UPTAKE THROUGH THE AIRWAY DURING PASSIVE SMOKING AND ITS EFFECT ON ANNOYANCE

A. Iwase, H. Saitoh, Y. Doi, M. Aiba, N. Yamauchi, T. Miyara & S. Kira (Department of Respiratory Medicine, Juntendo University, School of Medicine, Hongo, Tokyo, Japan)

To evaluate the extraction rate of nicotine from inspired air during passive smoking, the concentration of nicotine in inspired and expired air were measured in non-smoking and young female subjects. The subjects were exposed to passive smoking (5 cigarettes were burned every 10 minutes) for one hour in a $6 \times 6 \times 2.5$ meter sized room. A specially designed face mask which was able to separate expired air from inspired air with one-way valves was attached to the subject. The inspired and expired air were collected for two minutes with a nicotine sampler composed of a nicotine absorber, 450 mg of acid-treated diatomite, and a battery driven suction pump (suction rate 0.5 l/min). The outlet was connected to a dead space (350 ml) to avoid contamination with room air. The absorbed nicotine was measured with a gas chromatography with a flame thermionic detector (SHIMADZU GC-9A). Annoyance to cigarette smoke was monitored after air sampling –10, 10, 30 and 50 minutes after initiation of the exposure. Nicotine concentration in inspired air reached to 102.0 ± 17.9 µg/m^3 30 minutes after the initiation and was kept fairly constant throughout the study. The level of nicotine in expired air was less than 50% of that in inspired air. Despite of the fact that more than 50% of nicotine in inspired air was extracted through the airway, the annoyance was related neither to concentration in inspired air nor to the nicotine extraction. The results suggest that annoyance is likely due to personal perception or other components of the tobacco smoke.

O30 SENSORY RESPONSES TO ENVIRONMENTAL TOBACCO SMOKE FROM CIGARETTES THAT HEAT BUT DO NOT BURN TOBACCO

J.C. Walker, R.A. Jennings, W.T. Morgan, J.H. Robinson & J.H. Reynolds IV (R.J. Reynolds Tobacco Company, Winston-Salem, North Carolina, U.S.A.)

Sensory attribute ratings of 11 male non-smokers (18–24 years old) were measured during exposure to each of the following conditions: a) environmental tobacco smoke (ETS) from a

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Kentucky reference cigarette (K1R4F); b) ETS from an ultra-low 'tar' commercial cigarette (ULT); c) ETS from a cigarette that heats but does not burn tobacco (Test) and d) clean air. Tests were conducted in an environmental chamber in which temperature, humidity and air exchange rate were controlled or monitored. Concentrations of nicotine, respirable suspended particles and other constituents of the air were measured. During each 2-hour test session, a pair of smokers smoked two cigarettes during each of eight 6-minute periods; for the clean air condition, smokers "puffed" on unlit cigarettes. Non-smoker subjects were tested in pairs and rated, by marking a visual analog scale, the room air at the beginning of the session (pre-smoking) and at nine subsequent times throughout the session after smoking began, according to the following sensory attributes: Odor Strength (OS), Nasal Irritation (NI), Eye Irritation (EI), Annoyance (AN) and Overall Acceptability (OA). Responses on the different attribute scales were highly correlated (absolute value of Pearson r coefficients > 0.8). Ratings on the four "negative" attributes (all but OA) were 3.5–4, 3.1–3.4 and 1.5–1.6 times higher, than clean air, for the K1R4F, ULT and Test cigarettes, respectively. Throughout most of the time after smoking began, no statistically significant differences were seen in the ratings of ETS from the K1R4F and ULT cigarettes, which were both rated as less acceptable than either ETS from the Test cigarette or clean air. With the exception of the OS ratings after the first 6-minute smoking period, ratings of ETS from the Test cigarette were not statistically different from those of clean air (above results based on ANOVA with Duncan multiple range post hoc; $p < 0.05$). In general, for the OA attribute, ETS from the tobacco burning cigarettes, test cigarette and clean air were rated as follows: K1R4F = « Test ≈ Clean Air.

O31 NONSMOKERS ATTITUDE TOWARDS INDOOR AIR QUALITY

S. Shanmuganandan & P. Thirumalaikolundusubramanian (Department of Geography, Madurai Kamaraj University & *Department of Medicine, Madurai Medical College, India)*

Smoking eventhough prohibited in public places and in offices by law, it is rarely followed in India. Hence it is not uncommon to see menfolks (irrespective of educational and social status) smoking in public places, closed rooms such as cinema theatres, buses, trains, and office rooms amidst nonsmokers. An analysis of psychosocial factors (by questionnaire survey) with reference to the attitude of nonsmokers (M = 100, F = 100) on indoor cigarette smoke is presented. 90% of them accept even if his or her neighbours smoke, as they do not want to create displeasure or misunderstanding with them probably because of their sociocultural reasons. The remaining tried to explain the rules and request the smokers to stop smoking or inform the authorities concerned. As the cinema theatres projectslide showing the rules prohibiting the smoking inside the theatre, 95% of the study group are aware of this. In contrast to this only 42% of the study group are aware of prohibition of smoking in other public places, 22 of the 200 (11%) developed cough when their neighbours started smoking. Indian smokers stop smoking by themselves, if their neighbours develop symptoms due to smoke inhalation. One or more harmful effects of passive smoking were known only to 23% of the study group. In view of the non awareness and harmful effects of passive smoke, health care measures must be tuned to educate people by audio-visual means.

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O32 PERCEPTION OF DAILY CIGARETTE CONSUMPTION IN THE OFFICE ENVIRONMENT

D.A. Sterling, D.J. Moschandreas & R.D. Gibbons** (Old Dominion University, Norfolk, Virginia, *IIT Research Institute, Chicago & **University of Illinois, Chicago, Illinois, U.S.A.)*

A study was undertaken to investigate how closely smokers and nonsmokers agree in their perception of the number of cigarettes smoked. Information was collected by means of a self-report comfort and environment questionnaire. A secondary objective of the study was to determine whether repeated application of the same questionnaire had any effect on the responses over time. The information obtained from 163 respondents in 49 office work areas shows that nonsmokers perceived the number of cigarettes smoked within their office work areas as significantly lower than either the number perceived or the number reported consumed by smokers. There were no significant differences, however, between smokers' perceptions of cigarette consumption and their reported consumption. Repeated application of the same questionnaire, or sensitization, had no effect on either the smokers or nonsmokers and their perceived frequency of smoking.

O33 ACCUMULATION OF SEMI-VOLATILE CHEMICALS IN INDOOR-ENVIRONMENT

I. Gebefügi & F. Korte (Gesellschaft für Strahlen- und Umweltforschung mbH München, Institut für Ökologische Chemie, Neuherberg & Technical University of Munich, Institute of Chemistry, Chair of Ecological Chemistry, Freising-Weihenstephan, F.R. Germany)

Research activities in the recent years – field measurements and case studies resulted, that semivolatile chemicals will be accumulated on several surfaces. Laboratory investigation was made, to examine this accumulation effect on different textile fibres – natural and synthetical ones. In small model spaces the source surface, relative humidity and temperature were varied. Also the influence of the air exchange rate (ventilation) were studied. Biozide chemicals were selected for these experiments, they are usually taken for material preservation e.g. wood preserving paints, plasticiser preservers (polyvinilchloride) and others, mainly used as substitute for the now in Germany banned pentachlorophenol.

The chemical concentrations were determined by gas-chromatography with electron-capture detection. In one case (Furmecyclox) C-14-labelled chemicals were used for the verification and analytical results. The results of the laboratory experiments validate the earlier data, that semivolatile biozides like pentachlorophenol, lindane, dichlofluanid and furmecyclox will be accumulated from the air on textile surfaces, above all on cotton fibre surfaces.

Penta Chlor Phenol

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O34 ROLE OF COMBUSTION PRODUCTS IN BRONCHIAL HYPERREACTIVITY – A CASE CONTROL STUDY

M. Bert, J. Kühr, A. Hendel-Kramer, R. Urbanek, E. Schultz, H. Staiger* & W. Karmaus** (University Children Hospital, Freiburg, *German Weather Service, Freiburg & **Centre of Science, Berlin, F.R. Germany)*

In addition to genetic disposition pollution of indoor and outdoor air is discussed as an important pathogenetic factor in asthma. Eighty children were analyzed with a standardized questionnaire and skin prick testing with 10 aeroallergens for a case control study. Basing on confounding variables as sex, passive smoking and allergic sensitization 40 case control pairs were matched, The cases were defined as 'physician diagnosed asthmatics' and/or hyperreactive in an bronchial challenge test with carbachol. In the winter season pollutans in the outdoor air near the residences and in the indoor air of the dwellings as well as additional parameters of indoor climate in the houses were registered as variables of interest. Particulates and NO_2 were collected by passive sampling and analyzed by optical microscopy and ionchromatography respectively.

The best model to explain the status of case was fitted by conditional logistic regression analysis. In this final model a significant increased relative risk was found for high concentration of particulate combustion products in the indoor (odds ratio 6.5, 95% confidence interval 1.1–39.3, $p = 0.041$) and in the outdoor air (odds ratio 5.5, 95% confidence interval 1.1–27.3, $p = 0.036$) The use of stoves inside the dwelling and ventilation manners as well as NO_2-concentrations were not significant.

Therefore the inhalation of particulate combustion products might be considered as a potential risk factor for bronchial hyperreactivity as a common feature of bronchial asthma.

O35 USE OF MOLECULAR BIOLOGIC TECHNIQUES TO STUDY PULMONARY FIBROSIS

A. Poole, Smith Kline and French Research Ltd. (The Frythe, Welwyn, United Kingdom)

The activation of collagen synthesis during development of silicotic fibrosis was studied in rats exposed, in dusting chambers, to respirable SiO_2 for periods of 2, 4, 6 or 12 months. Control animals were exposed similarly to clean air or TiO_2. Development of fibrosis was followed by histological examination, measurement of lung weight and determination of lung collagen content (as hydroxyproline). A steady increase in lung weight and collagen content together with changes in cellularity and metabolic activity of the lungs, as ascertained by chemical determination of DNA and RNA, were measured in the lungs of the SiO_2 exposed animals. Hybridization of total lung RNA, extracted at each time point, with cDNA probes specific for type I and type III procollagen mRNA levels showed that the development of fibrosis was associated with increased levels, as compared to age matched controls, of pulmonary procollagen mRNAs. Interestingly, the highest levels of procollagen mRNAs were observed in young (pre-treatment control) animals, suggesting that during pulmonary development collagen metabolism in lungs is even greater than during development of fibrosis. In rats exposed to SiO_2 the increase in type III procollagen mRNA occurred earlier than the increase in type I procollagen mRNAs. These observations demonstrate both age-dependent and silicosis-related changes in pulmonary procollagen mRNA levels. The results suggest that development of silicosis is associated with an altered capacity of the lungs to regulate collagen accumulation.

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O36 GLUCANS AS POTENTIAL INFLAMMATORY AGENTS IN INDOOR AIR

R. Rylander, S. Sörensen, H. Goto, K. Yuasa* & S. Tanaka (Department of Environmental Hygiene, University of Gothenburg, Sweden & *Institute of Medical Sciences, Tokyo, Japan)*

Extensive symptoms of irritation in eyes, the nose and throat as well as cough and tiredness are present in many indoor environments particularly buildings where mould growth is present. In previous investigations in our laboratories we have demonstrated the importance of microbiological products (endotoxins) for acute and chronic symptoms in occupational lung disease. Moulds contain glucans which are known inducers of inflammation.

In view of the similarities between symptoms previously related to microbial products and those present in sick buildings a study was undertaken in 22 flats. Information on subjective symptoms was obtained with questionnaires answered by 35 respondents. Measurements of the level of airborne endotoxin and glycan were made in the bedrooms in the flats.

The results demonstrated that the proportion of respondents reporting irritation in the eyes, nose and throat as well as breathing difficulties and fatigue correlated to the amount of airborne endotoxin and glycan. The symptoms can be explained by the potential of these agents to induce inflammation. The results need to be verified in renewed studies but suggest that measurements of endotoxin and glycan are important for the control of indoor air quality.

β-1-glucan
β-1,3-glucan

O37 THE CONTRIBUTION OF UNVENTED NATURAL GAS COMBUSTION TO INDOOR AIR QUALITY

I. Billick (Gas Research Institute, Chicago, U.S.A.)

A systematic research program has been undertaken by the U.S. natural gas industry to determine the contribution of unvented gas combustion to indoor air quality.

The focus of this research is to determine the risk of population exposure to nitrogen dioxide (NO_2). Program elements include: emission characteristics of unvented gas appliances; factors which contribute to pollution levels in a dwelling unit; distribution of indoor levels of nitrogen dioxide; and the modeling and prediction of population exposure levels.

Emission rates for NO_2 have been measured for gas ranges and space heaters and other combustion sources, such as kerosene heaters. The emission rates for gas appliances appear to be independent of measurement protocols and most operating factors. For space heaters, there is a significant dependence on burner technology and both ranges and space heater emission rates increase with decreasing combustion air.

A number of other factors also contribute to the actual observed pollutant in the living space, including volume, appliance use rate and user habits, air exchange and reactivity with building materials or contents. Data on the impact of these factors have been obtained from both test house studies and large scale field surveys. The results show that reactive decay of NO_2 can often be a more significant removal mechanism removal than air exchange. In tight homes the reactive removal of NO_2 can often exceed the removal by air exchange by a factor of two. Studies undertaken to characterize the removal process show that the NO_2 is being converted to nitric oxide.

Several statistically designed field surveys have been carried out to measure the indoor NO_2 levels in cities like Boston and Los Angeles. Nitrogen dioxide concentrations were measured for several seasons and in various locations within dwelling units and outdoors. The results show

Source: https://www.industrydocuments.ucsf.edu/docs/lqdl0000

that about 50–75% of the outdoor NO_2 enters the home. In areas of high ambient NO_2, it is most significant contributor to the indoor NO_2, even when indoor NO_2 sources are present. Indoor levels are generally higher during the winter months, possibly due to decreased air infiltration and the use of ranges for space heating. Pilot lights were found to contribute about 15 ppb to the indoor NO_2 while range usage for cooking contributed about 10–15 ppb on the average. For those homes using blue flame unvented gas space heaters as their sole source of heat, the level of NO_2 was dependent on the difference between indoor and outdoor temperature.

Analytic and predictive models, using the survey data have been developed and will permit a reliable estimation of population exposure. This type of analysis can serve as the basis for policy decisions about the possible need for NO_2 exposure regulation and mitigation, and if it should prove to be necessary, alternatives for exposure control.

O38 AN EPIDEMIOLOGIC STUDY OF THE DOSE-RESPONSE RELATIONSHIP BETWEEN BAP CONCENTRATION IN INDOOR AIR AND LUNG CANCER MORTALITY IN XUAN WEI, CHINA

Xingzhou He & Wei Chen (Institute of Environmental Health and Engineering, Chinese Academy of Preventive Medicine, Beijing, China)

In Xuan Wei County, Yunnan province, lung cancer mortality is among China's highest and especially in females. Its total population is about one million people, over 90% of whom are farmers. There is a residentially stable population. Tobacco smoking is very rare in Xuan Wei females but common in males. For generations, local residents have traditionally been using one of three major fuel types "smoky" coal, "smokeless" coal, and wood. Fuel burning in shallow unvented pits has resulted in very high indoor air pollution levels. An epidemiologic study conducted in Xuan Wei County showed that Xuan Wei residents have unusually high lung cancer mortality that cannot be attributed to tobacco use or occupational exposure, lung cancer mortality rates are more closely associated with domestic smoky coal use.

Indoor air samples were collected during the burning of all three fuels, in contrast to wood and smokeless coal emissions, smoky coal emission has high concentration of submicron particles containing mutagenic organics, especially in aromatic and polar fractions, BaP levels are the highest in homes using smoky coal. In order to testify these hypotheses we developed quantitative risk assessment of BaP concentration in indoor air in Xuan Wei County. The results of logistic regression analysis indicated the obvious on-site dose-response relationship between BaP concentration and human lung cancer mortality and tallied with the formula: $P = 2.03 * 10^{-7} X^{1.7}$ (P: lung cancer mortality rate, X: BaP average concentration per day).

O39 VENTILATION, HEALTH AND ENERGY CONSERVATION A WORKABLE COMPROMISE

G. Robertson (ACVA Atlantic Inc., USA)

The accumulation of indoor air pollutants inside many buildings has been seriously exacerbated by design and operating practices, primarily aimed at saving energy costs.

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Two common denominators in many sick buildings are inadequate ventilation, specifically insufficient fresh air intake, and poor filtration. The latter is frequently a major contributor to a third common problem, namely the accumulation of dirt, dusts, and microbes inside the air handling units (AHUs) and their associated ductwork. Future building designs must address these faults. If the prime factor in the design of a building's ventilation system was the health of the employees rather than the maintenance of a specific temperature, far more emphasis would be given to minimum fresh air intake levels. Higher standards of filtration efficiency would be introduced and greater awareness of hygiene of the AHU systems would be essential.

In the USA, there is an increasing awareness of these issues. Enlightened building owners are moving towards prevention rather than cure. Significantly as they move towards preventing indoor air pollution from affecting the health of their staff or tenants, they realize financial savings through reduced absenteeism and improved productivity. Because of these financial returns together with a reduced risk of litigation, employers and building owners are proactively monitoring the air quality and overall operation of a building's ventilation system on a regular basis.

O40 SICK BUILDINGS CAN BE CONTROLLED THROUGH AIR QUALITY SPECIFICATIONS AND MONITORING

T. Aström (Västra Frölunda, Sweden)

On the basis of human experience, acceptance can be used as a measurement tool for determining air quality.

In an existing working environment, the adjustments in outdoor air intake necessary to obtain a desired acceptance level can be calculated. A relative measure of the contaminant source emission rate can also be obtained and this measure can be used when planning ventilation facilities in determining the dimensions for outdoor air intake. This would, in turn, make it possible to project facilities for which the acceptance levels were established in advance.

If the ordering party requests an 85% satisfaction level with regard to air quality, the necessary assessment effect can be established. This makes it possible to use acceptance as a quality criterion as early as at the stage of the preliminary tender enquiry.

O41 EVALUATING THE EFFECTIVENESS OF VENTILATION SYSTEM RENOVATIONS TO SOLVE SICK BUILDING SYNDROME

E. Sterling, A. Arundel & C. Collett (Theodor D. Sterling & Associates, Vancouver, Canada)

Ventilation air distribution problems involving system design, installation, operation and maintenance are often suspected of causing air quality problems that plaque many modern sealed office buildings. Such air quality problems have resulted in occupants suffering symptoms of discomfort and ill health commonly referred to as "Sick Building Syndrome".

Two case control studies of Sick Buildings will be described where ventilation retrofits were

Source: https://www.industrydocuments.ucsf.edu/docs/lqdl0000

undertaken to improve the health and comfort of building occupants. An office Work Environment Survey questionnaire was administered to all occupants in both buildings as a measure of the building environment and of occupants health and well being.

Occupants' perceptions were surveyed before and after ventilation retrofit. Control populations occupying Sick Buildings that were not retrofitted were also surveyed simultaneously for comparison purposes.

Number of symptoms improved and complaints declined after ventilation retrofits, while symptom/complaint rates remained constant for the control population occupying nonretrofitted sick buildings.

Design and conduct of the case control studies will be described in addition to ventilation retrofits and survey results.

O42 AEROALLERGEN SPECIES AND THEIR INDOOR/OUTDOOR RELATIONSHIP

D.A. Sterling & T.H. Stock (Old Dominion University, Norfolk & *University of Texas, Houston, Texas, U.S.A.)*

The term "aeroallergen" covers a broad list of agents able to produce allergic or other symptom responses. These include pollens, household mites, molds, animal dander and excreta, and insect parts. In conjunction with a major study of manufactured housing in four different climatical and geographical counties of Texas, simultaneous indoor and outdoor sampling for aeroallergens was performed. Aeroallergens were obtained by means of an intermittent rotorod sampler producing integrated seven-hour daytime samples. Subsequent microscopic analysis was performed for total count and speciation of pollens and spores. Speciation is an integral component of the indoor/outdoor air quality relationship and allergic potential.

In brief, overall indoor mean particle concentrations were 21 counts/m^3 for pollens and 136 counts/m^3 for spores. Homes with pollen concentrations less than 30 counts/m^3 comprised 82% of those surveyed; 84% of the homes had spore concentrations less than 250 counts/m^3. Observed variations in outdoor and indoor aeroallergen concentrations among counties were consistent with expected climatic and seasonal influences.

O43 QUELQUES EXEMPLES D'ÉTUDES D'AMBIANCES CLIMATISÉES

A. Mouilleseaux, F. Squinazi & B. Festy (Laboratoire d'Hygiène de la Ville de Paris, France)

Depuis quelques années, on observe chez les personnes travaillant dans des locaux climatisés, l'apparition de gêne et de troubles divers, d'origine encore inconnue et à prédominance ORL et oculaires, que l'on regroupe sous le concept de "Sick Building Syndrome". Des phénomènes allergiques ou infectieux (legionellose) sont plus rarement décrits. Le LHVP intervient à la demande des occupants des locaux.

Une visite préalable de l'installation et des locaux considérés, en association avec les médecins du travail et les équipes techniques de maintenance, permet de déceler d'éventuels problèmes et de préciser la campagne de prélèvements.

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La qualité d'ambiance à l'aide d'indicateurs globaux ou plus ou moins spécifiques de nature physico-chimique et microbiologique d'apprécie au mieux le confort thermohygrométrique, le degré de confinement (CO_2), de contamination microbienne (dénombrements de bactéries aérobies et de spores mycéliennes revivifiables) et d'"empoussièrement" ou même les teneurs d'autres indicateurs (oxyde de carbone, oxydes d'azote, actinomycètes...). Quelques exemples de stratégie de surveillance, choisie en fonction du problème posé (essais ponctuels, ou répétés à plusieurs moments de l'années comparaison air extérieur au niveau de la prise d'air neuf air intérieur, comparaison de la qualité de l'air dans deux immeubles climatisé/non climatisé en relation avec les plaintes du personnel seront discutés.

O44 REGRESSION MODEL FOR INDOOR CONCENTRATIONS OF COMBUSTION-GENERATED GASES

A. Hendel-Kramer, J. Kühr, R. Urbanek, H. Staiger, E. Schultz* & W. Karmaus** (University Children Hospital, Freiburg, *German Weather Service, Freiburg & **Centre of Science, Berlin, F.R. Germany)*

Combustion-generated gases (CGG) in the indoor air are dependent of indoor sources, ventilation characteristics (VC) and outdoor pollutant concentrations (OPC). To evaluate SO_2- and NO_2-indoor-concentrations as dependent variables NO_2 and SO_2 were sampled by Palmes-type diffusion tubes in 116 dwellings and in the outdoor air near the residences. Additionally the number of consumed cigarettes (CIG) , the kind of stoves (STOV), the energy used for cooking (COOK) and VC were registrated by questionnaire. Furthermore the average outdoor air temperature (TEMP) was calculated. A final model for the explanation of the SO_2- respectively the NO_2-indoor-concentration was selected by stepwise multiple linear regression routine. After transformation with natural logarithm a multivariate normal distribution of the residuals resulted. Parameter estimate (PAR) and probability (p) of significant independent variables in the final models are listed in the table below:

	Dependent Variables			
	NO_2-Indoor (n=428)		SO_2-Indoor (n=262)	
Independent Variable	PAR	p	PAR	p
OPC	0.005	0.0055	0.014	0.0001
TEMP	0.03	0.0003	−0.094	0.0001
VC	0.399	0.0002		
COOK	0.171	0.0007	0.42	0.02

If x is defined as increase of the independent variable the percentage increase of the dependent variable is: $(1-e^{PAR*X})*100$.

Therefore in our model outdoor pollutant concentration, outdoor air temperature and energy used for cooking but not CIG and STOV are significant predictors for indoor concentrations of NO_2 as well as SO_2. For NO_2 'ventilation characteristics' might be considered as associate predictor.

Source: https://www.industrydocuments.ucsf.edu/docs/lqdl0000

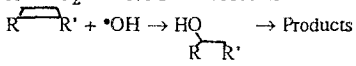
O45 RESIDENCE TIME OF VAPOUR POLLUTANTS IN THE ATMOSPHERE

M. Mansour (Institut für Ökologische Chemie, Freising Attaching, F.R. Germany)

In order to reduce the potential hazards of chemicals to the environment a knowledge of the influence on human beings and their effects in the aquatic environment is necessary. A comprehensive and thorough study of the effects of some substance classes, which are found distributed in the environmental compartments, can be considered as an approach of evaluating the risks to health of men and animal and to prevent such risks. It is necessary to have available accurate informations about the fate and behaviour of these chemicals in different environmental compartments.

In the atmosphere some oxidation processes lead to a degradation of organic environmental chemicals. Our knowledge of all these chemical reactions is still insufficient. The photoinduced decomposition of organic chemicals in the atmosphere can occur directly or indirectly. In the first case of a direct photolysis the molecule absorbs in the range of the sun spectrum (290–450 nm) and continues the reaction without the influence of a second species Under the influence of solar irradiation photochemical reactions are caused producing highly reactive species. The OH-radicals chiefly attack the organic compound by abstracting a hydrogen atom from the molecule, resulting in the formation of organic radicals which themselves can initiate several chain reactions. They can in the presence of an organic compound, RH, proceed according to the equation below:

$$RH + OH^{\bullet} \rightarrow H_2O + R^{\bullet}$$
$$R^{\bullet} + O_2 \rightarrow ROO^{\bullet} \rightarrow \text{Products}$$



With alkenes and aromatic compounds addition also occurs.

In further experiments we irradiated benzene in a 20 l flask in the presence of NO_2 as well as NO_2 and ethan, isobutan respectively ($\lambda > 290$ nm).

O46 A CZECHOSLOVAK SURVEY ABOUT VENTILATION HABITS IN DWELLINGS

L. Pirsel (Slovak Technical University, Bratislava, Czechoslovakia)

As a mean to collect necessary statistical informations about the actual state of indoor-climate in dwellings and about the habits of their users two surveys were started which will continue in the future. The first (1985) as a pilot project and the second (1987) as a representative study. There were observed temperatures, habits affecting indoor-climate's quality and its subjective evaluation.

A combined method was used consisting of measurements and questionnaire inquiry performed during January and February. Indoor-air temperatures were measured in the centre of the living rooms and bedrooms and the questionnaire formed 13 prescribed and 1 free questions.

The results of both surveys are in good agreement with each other. Only about 43% of users had been determined to be satisfied with the air humidity whereby the majority (56%) complained "dry air" in spite of 59% using artificial humidification. The most frequent kind of ventilation was opening windows more than 3 times a day (37%) for 15 min. (31%) or longer than 1 hour (31%) respectively. Frequency and duration are strongly influenced by obstructions like noise, dust and odours outdoors. Subjective evaluations were worse in new buildings and the rate of dissatisfied increased from 24% in dwellings built before 1945 to 79% in those built after 1981.

We suspect chemical substances evaporating from building materials like formaldehyde to cause "dry air" more than the actual air humidity. Unfortunately indoor-air concentrations of pollutants were not measured and the hypothesis should be verified in future. The former statement could be deduced from the fact that complaints increased in dwellings with high application of materials like plywood, fibre-board and wood-fibre. This should be a great warning for designers, hygienists and building industry. The fact that people do like opening windows regardless of indoor-air temperature and thermal sensation should be reflected when predicting energy consumption for heating as well.

O47 EMISSIONS FROM BUILDING MATERIALS. THE ROLE OF ADDITIVES IN PVC-MATERIALS

K. Saarela, K. Kaustia & A. Kiviranta (Technical Research Centre of Finland, Chemical Laboratory, Espoo, Finland)

Hundreds of organic compounds have been detected in indoor air. A part of these are known to originate from building materials. This has led to a demand to strive towards chemically cleaner materials. Floors and walls are the largest emitting surfaces in an apartment. PVC-based materials are frequently used both as floor and wall covering materials.

PVC-materials are known to emit numerous organic compounds from aliphatic and aromatic solvents to phtalates and even phenol. The amount and the time dependence of the emissions vary from producer to producer and even from material-lot to another.

The material producers do not always know the composition and consequently not the potential impact of their raw materials used in production of building materials on indoor air.

This study was undertaken to shed light on the emission sources in plasticized PVC-materials. Typical stabilizers, plasticizers and viscosity modifiers were evaluated for their composition and content of total volatile organics. The emissions of the components were screened by head-space technique using GC/MS-identification.

According to the results the stabilizers may contain a dozen of organic components, mainly of solvent type but even other types are present in varying amounts some of which are volatile. Plasticizers and viscosity modifiers contain smaller amounts of secondary compounds, but yet there are differences in the volatility of the plasticizers and viscosity modifiers.

The study suggests that there are differences between similar additives and the knowledge of this fact can be used in developing low emitting plasticized PVC-products.

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Source: https://www.industrydocuments.ucsf.edu/docs/lqdl0000

O48 INFLUENCE OF INDOOR AIR POLLUTION ON NO_2 PERSONAL EXPOSURE LEVELS OF SCHOOLCHILDREN

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The study was designed to clarify the influence of air pollution, passive smoking, and indoor air pollution from heating apparatus on NO_2 personal exposure levels. The research was conducted from September 1985 to March 1987, on a total of 5,383 schoolchildren from 5 areas. NO_2 personal exposure levels and outdoor air pollution levels were measured. The presence of smokers in the home on the survey day, heating apparatus and their use, and house construction were all noted. The following results were obtained.

(1) NO_2 personal exposure levels in winter, when heating apparatus were used, were almost twice as high as in other seasons.
(2) Average levels of personal exposure broken down by heating apparatus type revealed approximately twice as high values for heating apparatus without a ventiduct than for those with a ventiduct.
(3) When heating apparatus were not used, NO_2 personal exposure levels for the group with family smokers registered slightly higher values than for those with no family smokers. When heating apparatus were used, these differences disappeared.
(4) A predicted equation to estimate NO_2 personal exposure levels was arrived at through multiple regression analysis. NO_2 personal exposure levels were designated as the objective variable, while ambient air pollution levels, use of heating apparatus without a ventiduct, house construction, passive smoking and climatic conditions (temperature) were designated as explanator variables. Application of this predicted equation to other areas outside the scope of the original study resulted in a significant correlation between the predicted and the observed values.

O49 STATISTICAL SIGNIFICANCE OF HOME INDOOR AIR FUNGAL SPORE SAMPLES IN TIME AND SPACE

M.J. Jantunen, A. Nevalainen, A.-L. Pasanen & P. Kalliokosi* (National Public Health Institute, Kuopio & *University of Kuopio, Finland)*

The objective of this study is to determine the statistical representativeness of home indoor air fungal spores samples taken with standard six stage cascade impactors (15 min per sample) and plain Ø11 cm settling plates (1 h per sample). The samples represent conditions of minimum but realistic variation, i.e. outdoor windows and doors were not opened, food was not prepared, and no cleaning or vacuuming was allowed. The timing of this study was winter, with frozen and snow covered soil and minimum outdoor spores counts. Four typical urban homes were chosen, and each was sampled for 5 h. Two impactors were run at a central location in the living room of each home 15 min each to allow continuous sampling, and sets of three settling plates were left open, and replaced after each hour in each room. Malt extract agar was used for the growth medium.

The 19 15 min samples taken with the impactor yielded an average of 383 cfu with a standard deviation (SD) of 10,5%. The 15 1 h settling plate samples, exposed in the same living room, yielded an average of 7,5 cfu with an SD of 32%. When 3 simultaneously exposed plates were grouped as one sample, the SD was reduced to 19%, and when 6 plates representing two hours

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were grouped, the SD was further reduced to 13%. This is the same number of plates which each impactor sample consists of, so we can conclude that while sampling indoor air fungal spores, nearly the same precision can be achieved by exposing 6 agar plates to settling spores for 2 h, than by taking one 15 min impactor sample.

Based on 75 settling plate samples the SD of the 5 h overall fungal spores counts in the 5 rooms was 28%.

O50 INDOOR POLLUTION BY MINERAL FIBERS

J. Bignon, G. Dufour, P. Brochard & A. Gaudichet** (*Cliniquement de Pathologie Respiratoire et Environnement, INSERM 139, Créteil, *Laboratoire d'Etude des Particules Inhalées, DASES, Paris & **Lamaast, Université Paris XII, Créteil, France)*

The widespread use of asbestos fibers and more recently of man made mineral fibers (MMMF) as insulation products in buildings can be a potential source of indoor pollution.

Concerning *asbestos fibers*, many measurements have been conducted worldwide but comparison are difficult because of discrepancies in methods for sample collection, analysis (optical microscopy, scanning or analytical transmission electron microcopy (ATEM)) and interpretation. Since 1975, our laboratory have performed about 1000 analysis by ATEM, expressed in mass concentration: 44% of the samples were above the outdoor pollution background level (i.e.: < 7 ng/m^3 for chrysotile and absence of amphibole fiber). Only 10% of these samples were above 50 ng/m^3 (ambient air quality standard proposed in 1979 by the "Conseil Superieur d'Hygiène Publique de France", as measured by ATEM). A retrospective study is now in progress in order to compare new measurements expressed in numerical concentrations from the same sample than those previously used for expressing the results in mass concentrations. The numeration with ATEM is conducted on fibers longer than 5 µm. The preliminary data showed a relative good adequation between mass and numerical concentrations when considering separately chrysotile and amphibole fiber types.

By contrast, very few data are available on MMMF indoor air pollution. Since 1981, our laboratory has carried out 79 measurements inside buildings and 18 outdoors, using polarizing optical microscopy. Indoor pollution levels were found to be in the range of 0 to 6 respirable fibers per liter with a median value of 0.003, outdoor airborne levels were lower than 0.02 respirable fibers per liter, with a median value of 0.001 f/L.

In conclusion, for asbestos indoor air pollution, the ATEM method is the recommended one. As concentrations expressed in fibers/ml seems more appropriated for a better evaluation of the indoor risk assessment, extensive new surveys have to be carried out, since a lot of previous data were expressed in mass.

The methodology of MMMF indoor measurement in air needs also to be standardized, regarding sampling as well as analysis which must be adapted to this type environmental setting which needs to be internationally standardized.

Source: https://www.industrydocuments.ucsf.edu/docs/lqdl0000

O51 INDOOR AIR QUALITY, HOUSING AND HEALTH

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The influence of natural climate on health is an environmental dimension of considerable consequence. Variables such as temperature and heat transfer, barometer pressure, precipitation, humidity, ionization, air flow, visible light, ultraviolet and infra red radiation have their effects on man and they depend upon an individual's living location. Human comfort is closely associated with well-being. The present study has made an attempt to bring out the importance of indoor air quality in relation to ventilatory facilities, housing and environmental health. Indeed the ventilatory facilities is emerged as one of the major socioeconomic dimensions to explain its interrelatedness with the disease variables such as respiratory diseases, skin diseases and cardiovascular illnesses. More scientifically, the average individual at rest will inhale about 8 litres of atmosphere per minute. The rate of inhalation may be as high as 115 litres per minute. The respiration gradient between work and rest may be as great as 14. An increase in absorption of air pollution factors for the individual at work may be as much as 14 times higher than the rate during rest, depending on the degree of his activity. Ventilation in the house is an essential factor to allow outdoor air to flow into indoor to maintain indoor air quality and at the same time to protect people from indoor air contaminants. It is therefore essential that Clean Air Act must be introduced to develop a plan for the implantation, maintenance and enforcement of the national ambient air quality standards besides enhancing the quality of air resources so as to promote the public health and welfare. This study is based on a field survey (based on the interview survey) carried out at 35 primary health centres consisting of 1190 sample respondents.

O52 THE ACAREX/ACAROSAN CONCEPT, ITS POSSIBILITIES IN ALLERGOLOGY AND DERMATOLOGY

J.E.H.M. van Bronswijk & G. Schober (Interuniversity working group Home and Health, Utrecht State University, Utrecht, The Netherlands)

The Acarex/Acarosan concept was developed to perform an effective, safe and practical home sanitation against house dust mites (Pyroglyphidae) and their allergens. House dust mite allergy is a major problem in a considerable part of the world. Preventive measures, such as avoidance of allergen exposure by reducing the mite content of dwellings, are widely advocated. Effective management of the allergen producing mites calls for infestation prevention and extermination of bring mites, as well as for allergen removal. This should be performed in all dwelling niches inhabited: textile floor and wall coverings, badly sealed wooden floors, non-washable heavy curtains, padded furniture, mattresses, pillows, blankets, quilts and eiderdowns, as well as other home textiles. An inventory of the problem niches by means of a color reaction on mite excrements (Acarex test) is performed first, followed by a combined cleaner-acaricidal treatment (Acarosan) of the more highly mite-populated and polluted surfaces. A once or twice yearly treatment was found both practical to the inhabitants, and effective in reducing the allergen load to below hygienic limits. Since Acarosan has been formulated as both a powder and a dry foam, all types of home textiles may be treated, making for the first time sanitation of the complete dwelling possible. Oral, dermal, and inhalation toxicity tests on laboratory animals proved the Acarosan products to be neither toxic nor causing irritation (eye, skin) or delayed contact hypersensitivity (skin). Considering the different components of the formulation, only a slight to very slight theoretical risk for dermatitis appears possible for persons already sensitized to isothiazolin-derivates or acrylate-monomeres. However, those phenomena have not been observed among the users of Acarosan.

By improving the indoor air quality as far as mite allergens is concerned, the Acarex/Acarosan concept has brought an effective allergological home sanitation within reach of most atopic patients (suffering from asthma, rhinitis, conjunctivitis or atopic dermatitis) in Western Europe and North America. In addition Acarosan may be useful in the treatment of some cases of human parasitic papular urticaria.

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O53 LUTTE CONTRE LES EXCRÉMENTS D'ACARIENS PORTEURS D'ALLERGENES DANS L'AIR AMBIANT

E. Bischoff (Gesellschaft für Hausbiologische Forschung, Mainz, F.R. Germany)

Problème: L'importance médicale des polluants d'origine biologique, surtout ceux des allergènes contenus dans l'air ambiant, est très grande pour les personnes allergiques. Environ 99% des allergènes dûs aux acariens de la poussière de maison sont contenus dans leurs excréments d'où ils se propagent dans l'air ambiant.

Méthodes et résultats: Nous référons sur la détection des excréments des acariens dans la poussière, à l'aide d'une méthode nouvelle, basée sur une réaction colorimétrique avec la guanine, substance du métabolisme des acariens. Le taux de guanine contenue dans 1 g de poussière peut varier de 0 à 40 mg, le plus souvent il est compris entre 0,6 et 20 mg, ce qui correspond à un taux d' allergènes Der Pl ou Fl de 2 à 100 µg. Nous démontrons les résultats de l'élimination des acariens à l'aide de produits à base de benzoate de benzyle solidifié. Les maisons traitées sont observées pendant 2 à 3 ans. Avant traitement le nombre des acariens varie de 100 à 10.000 selon les cas. Une semaine après le traitement, ils ont complètement disparus. La quantité des excréments présents sur les objets où se trouvaient les acariens diminue plus lentement, 2 à 6 mois après le traitement le taux de guanine est inférieur à 0,6 mg/g.

Selon l'échelle MAC (Mite Antigen Content), cette valeur correspond à un contenu en allergène Der Pl < 2 µg/g, normalement sans risque pour les personnes allergiques (Platts-Mills et. al. (1985) Int. Archs All. appl. Imm. 77, 163–165), Bischoff et. al. (1987) EXS 51 190–196).

Résumé: la détection colorimétrique des excréments met en évidence les sources de ces contaminants dans la poussière. L'élimination des acariens vivants permet la diminution des excréments. Le contenu en allergènes des acariens dans l'air ambiant disparaît ainsi que le danger pour les personnes sensibilisées.

O54 DEVELOPING AN EFFECTIVE RESPECTIVE ON THE RISKS AND CONTROL OF INDOOR AIR POLLUTANTS

A.V. Nero Jr. (Lawrence Berkeley Laboratory, USA)

More than a decade of research has indicated clearly the substantial exposures and potential risks associated with pollutants in indoor air, as well as provided the technical basis for controlling exposures of key pollutant classes, including combustion emissions, volatile organic compounds,

Source: https://www.industrydocuments.ucsf.edu/docs/lqdl0000

radon and its decay products, and biologic organisms. What has been lacking, however, is an effective and acknowledged perspective on the acceptability of risk in the indoor environment and on the corresponding formulation of strategies for controlling excessive concentrations. As a result, governmental, institutional, and personal actions have occurred primarily by applying criteria and strategies developed for other exposure settings to the indoor environment, often leading to unsuitable, ineffective, or even counterproductive actions. In contrast, an effective perspective on indoor risks, including the acceptability of various risk levels, can be gained by considering differences in risks and benefits, as well as in the allocation of choice, control, and responsibility, among the different settings where we spend most of our time – i.e, the outdoor environment, workplaces, homes, and transportation. Such an examination suggests that we should not expect that risks can be constrained to the levels possible for pollutants in outdoor air, water supplies, or food, but rather that they ought to be more similar in magnitude to risks we experience in occupational settings or to the risk of accidents in our homes and cars all of these tend to be "indoor" settings where we derive some direct benefit from our presence, and hence from our willingness to suffer associated risks. Furthermore, the key elements in formulation overall control strategies – i.e, a system of exposure limiting guidelines, the means for identifying buildings with excessive levels, and a framework for selecting appropriate control techniques – must be developed in view of the peculiar characteristics of the indoor environment and the various responsibilities of those who own occupy or regulate it. Only in this way can effective and sensible control strategies be developed.

O55 NEW CONCEPTS OF CONTROL AND PREVENTION IN RESIDENTIAL DESIGN AND CONSTRUCTION

P. Bierman-Lhytle (The Masters Corporation, New Canaan, Connecticut, U.S.A.)

OBJECTIVE OF STUDY: The presentation will show new approaches in architectural design and in construction techniques and alternative building products and materials in USA residential construction. Projects selected will demonstrate a wide spectrum of homeowners, from the standpoint of health and chemical sensitivities to economic budgets, from urban settings to rural and remote environments.

METHOD OF STUDY: The homeowners have been distinguished by categorizing their health sensitivities into three levels:

Level 1: Non-chemically Sensitive
Level 2: Chemically Sensitive, Tolerant
Level 3: Chemically Sensitive, Intolerant

By this separation one is able to better select design approaches and specify more appropriate building techniques and alternative building materials that are not a threat to the occupant's health. This is because certain products and materials safe for one group of occupants are not always safe for others.

These projects represented in the presentation were designed by The Masters Corporation and constructed by The Masters Corporation, an architectural/master building firm specializing in healthier built environments. All projects depicted have been constructed and are occupied.

RESULTS OF STUDY: Full specific breakdowns of alternative building components are available. The lists include non-toxic, non-flammable Air Krete insulation, non-toxic paints and wood finishes represented by four European and American manufacturers (Auro, Livos, AFM, Murco); alternatives to pressure-treated lumber (Pau Lope and beechwood distillates); natural

linoleums and carpeting; non-toxic and non-flammable wall panels from Finland; roof shingles from Belgium; air handling equipment and air filters; radon mitigation systems; and computer systems for the occupant to monitor the quality and performance of their home. Samples and brochures will be available at the Poster.

CONCLUSIONS OF STUDY: Economically, the three Levels result in average increased costs to an occupant by 10% for Level 1; 15–20% for Level 2; and 25–30% for Level 3. Evaluation of off-gassing of some suggested safe products show unacceptable comfort levels for certain occupants from Level 2 and 3.

Home Maintenance systems show favorable acceptance by home occupants. New products which are inert show great promise for Levels 2 and 3 occupants.

O56 PORTABLE AIR SAMPLER FOR MEASUREMENTS IN AIRCRAFT AND PUBLIC BUILDINGS

J.F. van der Wal (MT-TNO, Delft, The Netherlands)

Objective

The objective of the design of a portable air sampling unit is unobtrusive measurement of components of the environment of the passenger cabin aboard of aircraft and public rooms such as restaurants.

Instrumentation

A portable air sampling unit was designed for the objective. An unobtrusive, reliable, (electrically) safe, silent and simple to operate instrument was required. All sampling and monitoring equipment is contained within an ordinary briefcase with a double lid. The heart is a central sampling tube containing successively a temperature/RH probe, an on light scattering principle based respirable dust monitor, a filter holder and a fan. The power is delivered by a rechargeable battery connected with a vacuum membrane pump. The pump is connected with two adsorption tubes, a filter holder and a sampling bag. All electric signals from the sensors are stored on a meter/logger.

Application

During about 50 flights the following components were measured in aircraft respirable dust (filters; tyndallometer), nicotine (XAD-adsorption tubes), CO and CO_2 (plastic bag), temperature, RH and barometric pressure. The battery tension was also monitored. From the about 200 samples or recordings collected of each component more than 90% gave reliable results.

O57 DEMAND CONTROLLED VENTILATING SYSTEMS, NEW CONCEPTS FOR INDOOR AIR QUALITY AND ENERGY CONSERVATION

L. Trepte (Dornier-System, Friedrichshafen, F.R. Germany)

Recent results of international investigations have shown that demand controlled ventilating systems represent most promising technics for linking energy conservation and indoor air

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quality. They offer possibilities to follow ventilation strategies which ensure air exchanges large enough to avoid risks for the health of occupants and the building fabric and air exchanges as low as possible for energy reasons. The minimum air exchange need is in the order of 8 l/s per person and strongly dependent on number of persons, seasonal effects and kind and type of indoor air pollutant. Moisture and humidity may effect the building fabric especially in the transitional seasons and result in mould growth, also if no or few people are present. Therefore a basis ventilation rate in the order of 0.5 air changes per hour is recommended, as e.g. in the draft of a German ventilation standard. Other indoor pollutants are related more directly to the number of persons, a reason for an additional ventilation rate. Most important are ventilation technics of high ventilation efficiency, and for many applications displacement ventilation will have advantages related to dilution systems. Therefore leading substances for such new and advanced systems may be a.o. carbon dioxide, moisture and odour. Market analysis have shown a lack of appropriate sensors. A consequent further development of these systems will come to concepts of intelligent buildings which integrate energy management, ventilation and indoor air quality as well as communication and safety and security aspects.

O58 A DATABASE OF PROBLEM BUILDINGS: LEARNING BY PAST MISTAKES

C.W. Collett, E.M. Sterling, T.D. Sterling & J.J. Weinkam* (Theodor D. Sterling & Associates, Vancouver & *School of Computing Science, Faculty of Applied Sciences, Simon Fraser University, Burnaby, Canada)*

Designers of modern office buildings attempt to create "healthy buildings", with satisfactory indoor environmental conditions for occupants. However, research has shown that many buildings are "sick", with occupants reporting a wide range of health and comfort problems. These problems have adversely effected productivity through higher absenteeism and increased stress.

To effectively develop buildings in the future, designers must identify those factors which have caused past environmental problems in order to avoid similar problems in the new buildings. Valuable information for designers is available from the results of past building investigations. An information system (BPD: The Building Performance Database) containing the results of 400 published and unpublished investigations conducted by Government and private agencies has been developed as a tool for building professionals and researchers.

BPD is an on-line collection of information which allows researchers to consolidate and search through large amounts of data from single or multiple buildings regarding such parameters as building materials, energy use, ventilation, lighting, acoustics, indoor air pollutant levels, and reported effects on the health and comfort of occupants. BPD is installed on a main frame system and can be accessed worldwide through existing communication networks.

Examples of how designers can effectively use the information contained in the database to develop "healthy buildings" will be discussed.

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O59 PROGRAMME DE TRAITEMENT EN VUE DE LA LUTTE CONTRE LA POLLUTION MICROBIOLOGIQUE INTERNE OCCASIONNÉE PAR LES INSTALLATIONS DE CLIMATISATION MAL ENTRETENUES

E. Clement (De Kobra, Opwijk, Belgique)

Objectif:
Un programme efficace pour le nettoyage et la désinfection est établi en se basant sur la conception de l'installation et en tenant compte de son degré de pollution. La flore microbiologique détectée, soit a l'intérieur du bâtiment, soit dans les différentes parties de l'installation, entre également en ligne de compte.

Résumé:
Après plusieurs enquêtes, l'on a pu conclure que la pollution interne est due principalement à la présence d'organismes microscopiques. Dans le cadre de l'enquête sur les causes des différentes plaintes formulées dans les établissements insalubres, il est nécessaire que cet aspect soit pris en considération.

Un manque d'entretien est dans la plupart des cas à la base de concentrations excessivement élevées d'organismes microscopiques dans l'atmosphère intérieure. Il en résulte une accumulation de crasses et de poussières à l'intérieur de l'installation, ce qui constitue, sous l'influence de la température et de l'humidité, un milieu de culture idéal pour le développement d'une riche flore microbiologique.

Un programme efficace de telles installations polluées doit tenir compte des lois générales de désinfection.

Il doit être adapté aux caractéristiques de l'installation, ainsi qu'à son degré de pollution.

Il faut que, pour l'exécution de ce programme, les stades suivants soient systématiquement parcourus:

- contrôle visuel du degré de pollution de toutes les parties de l'installation;
- constatation des parties vulnérables de l'installation qui pourraient favoriser un développement microbiologique;
- constatation et comparaison de la flore microbiologique survenant dans l'atmosphère intérieure d'une part et extérieure d'autre part et celle se manifestant dans chaque partie de l'installation;
- dépoussiérage mécanique et/ou chimique et nettoyage de l'installation;
- sélection au moyen de deux méthodes mises au point, des produits de désinfection, afin d'éliminer les détritus de la flore microbiologique contaminante;
- exécution d'un programme de désinfection et éventuellement de désinfection supplémentaire;
- contrôle final et élaboration d'un programme de prévention.

O60 PRESENT AND FUTURE EXCEEDENCE OF HEALTH RELATED REFERENCE VALUES FOR AIR POLLUTANTS IN DUTCH DWELLINGS

H.J. van de Wiel & E. Lebret (National Institute of Public Health and Environmental Protection, Bilthoven, The Netherlands)

Indoor air quality has been investigated for the Dutch housing stock taking into account pollutants for which national and international health organizations published no effect levels or

Source: https://www.industrydocuments.ucsf.edu/docs/lqdl0000

levels of specified avoidable risk ($10^{-6}y^{-1}$). As a measure of indoor air quality for a particular pollutant is taken the percentage of Dutch homes exceeding this health related limit value. From the 30 substances considered the highest percentages were scored by nitrogen dioxide (appr. 90%), radon entering the house through the floor (appr. 80%), particulate matter (appr. 60%) and "dampness", used as an indicator for the potential presences of housedust mite and mould allergen (appr. 15%).

Future trends are based on expected social, economical and technical developments together with current government policy. Generally, the trend is downwards especially for the minor substances. However, the top four remain high in the coming decades if no additional measures are taken. The calculated percentages for 2010 are appr. 65% (nitrogen dioxide), appr. 80% (radon), appr. 35% (particulate matter) and appr. 13% ("dampness").

O61 Abstract withdrawn

O62 LES ACTIONS FRANÇAISES DE RECHERCHE INCITATIVE POUR LA MAITRISE DE LA QUALITÉ DE L'AIR INTÉRIEUR DES LOCAUX HABITABLES

J.P. Marie & P.C. Jacquignon (*Plan Construction et Architecture & Secrétariat d'Etat à l'Environnement, Paris, France)*

Les innovations techniques, notamment celles liées aux économies d'énergie ou au conditionnement d'air, la protection contre des environnements polluants, l'évolution des modes de vie et plus généralement la recherche légitime d'une plus grande qualité motivent en france comme en bien d'autres pays industrialisés le lancement d'actions de recherches spécifiques pour des constructions plus saines.

Les problèmes de maîtrise de pollution de l'air intérieur des locaux habitables sont apparus particulièrement prioritaires pour le Plan Construction et Architecture du Ministère de l'Equipement et du Logement et le SRETIE (Service de la Recherche, des Etudes et du Traitement de l'Information) du Secrétariat d'Etat à l'Environnement.

D'ores et déjà un premier programme de recherche a été lancée en 1987 conjointement par le Plan Construction et Architecture (action Habitats et Santé) et la SRETIE (Programmes "Santé et Environnement" et "POLILOC" du "Groupe Air"), avec les participations du Ministère de l'Education Nationale et du Ministère de la Santé, et en liaison avec l'Agence Française de Maîtrise de l'Energie (AFME).

Ces travaux concernent l'habitat et les équipements tertiaires (écoles, bureaux, hôpitaux, ...). Il est proposé d'en présenter le panorama.

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O63 VENTILATION SYSTEM RETROFITS AS A METHOD OF SOLUTION FOR THE SICK BUILDING SYNDROME

E.M. Sterling & C.W. Collett (Theodor D. Sterling & Associates, Vancouver, Canada)

Ventilation problems involving system design, installation, operation and maintenance are often suspected of causing air quality problems that plague many modern sealed office buildings. Such air quality problems have resulted in occupants suffering symptoms of discomfort and ill health commonly referred to as "Sick Building Syndrome".

To examine the relationship between sick building syndrome and ventilation problems, occupants of two buildings were surveyed using a questionnaire. Responses from both buildings indicated health and comfort problems typically associated with sick buildings. Ventilation system retrofits were undertaken in one of the buildings, but not the others. Following completion of the retrofits, the occupants of the building were resurveyed.

Occupant perceptions about health and comfort improved in the retrofitted building, whereas the prevalence rate of responses were unchanged in the non-retrofitted building. The study shows that ventilation system retrofits can be effective in improving indoor environmental conditions, and illustrates the relationship between ventilation inadequacies and the sick building syndrome.

Source: https://www.industrydocuments.ucsf.edu/docs/lqdl0000